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Glenn Safety Manual – Chapter 16

Confined Space Entry

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Change Record

Rev.	Effective Date	Expiration Date	GRC25, Change Request #	Description
A	10/5/2011	10/5/2016	34	Clarification of duties and tasks, addition of text boxes as a guide to how requirements will be verified.
Change 1	5/2/2014	10/5/2016	N/A	Administrative change to add front cover and change history log to comply with NPR 1400.1
Change 2	9/30/2015	10/5/2016	N/A	Administrative change to remove hyperlinks.
B	11/09/2016	11/09/2021	16-013	Revision to include reference to new OSHA 1926 Confined Space Standard

***Include all information for each revision. Do not remove old revision data. Add new rows to table when space runs out by pressing the tab key in the last row, far right column.*

Contents

Chapter 16—Confined Space Entry

NOTE: *The current version of this chapter is maintained and approved by Code QSS, Operational Safety Branch (OSB). The last revision date of this chapter was November 2016. The current version is located on the Glenn Research Center (GRC) intranet within the BMS Library. Approved by Chief of Safety and Health Division.*

1.0 PURPOSE

This chapter provides guidelines for the evaluation of, safe entry into, and work in confined spaces at the Glenn Research Center (GRC) Lewis Field and Plum Brook Station.

2.0 APPLICABILITY

This chapter is applicable to all civil servant and contractor employees assigned to GRC sites and to any NASA-controlled, Government-owned facilities associated with GRC.

3.0 BACKGROUND

The Occupational Safety and Health Administration (OSHA) issued the general industry confined-spaces rule (29 Code of Federal Regulations (CFR) 1910.146, Permit-Required Confined Spaces) on January 14, 1993. The Occupational Safety and Health Administration (OSHA) defined two general classes of confined spaces: a confined space requiring no permit for entry and a permit-required confined space (PRCS) containing a hazard or hazards. A PRCS designation requires the development and implementation of specific procedures to ensure the safety of employees who enter a PRCS. The rule contains guidelines for developing a written confined-space program, monitoring atmospheric hazards, training employees, preventing unauthorized employees from entering these spaces, providing for both non-entry and entry rescue, and maintaining records.

Both the general industry and construction industry standards specify a limited exception from some of the PRCS requirements when the only hazard in a confined space is an atmospheric hazard, and ventilation equipment will control the atmospheric hazard at safe levels. Both also require protection to employees from non-atmospheric (e.g., physical) hazards within confined spaces.

The general industry standard does not specifically apply to construction employers. The OSHA issued 29 CFR 1926 Subpart AA, Confined Spaces in Construction, with an effective date of August 3, 2015. There are minor changes required for the GRC Confined Space Entry Program to meet the requirements of Subpart AA. Those primarily deal with the roles defined by the new regulations. These are discussed later in this chapter.

4.0 POLICY

All personnel at GRC shall comply with the GRC Confined Space Entry Program unless specifically exempted by the Operational Safety Branch (OSB) Chief.

Standards for the safe work in PRCSs at GRC shall comply with 29 CFR 1910.146, 29 CFR 1910.268, 29 CFR 1910.269, and 29 CFR 1926.1200-1926.1213. Work in PRCSs at GRC may also be classified as a hazardous operation as defined in NASA Policy Requirement (NPR) 8715.3, NASA General Safety Program Requirements. All confined spaces at GRC shall be considered PRCSs until otherwise determined by OSB. This includes all excavations that a worker may enter. Spaces permanently identified as PRCSs shall be identified on the Permit-Required Confined Space Inventory maintained by OSB. The OSB shall be notified in writing or electronically of any changes to PRCSs or of any new or removed PRCSs.

A Confined Space Working Group shall be established at GRC for the purpose of reviewing and resolving concerns regarding confined spaces.

5.0 RESPONSIBILITIES

5.1 Operational Safety Branch (OSB)

The OSB is the designated branch within the GRC Safety and Mission Assurance Directorate required to develop and oversee a safety program for entries into confined spaces at GRC (NPR 8715.3 Section 7.4 Requirement 25106). The responsibilities include, but are not limited to:

- Maintain this chapter to meet current regulations and standards in accordance with guidance provided by OSHA, NASA Headquarters, and other organizations providing nationally accepted consensus standards.
- Chair the Confined Space Working Group formed from a representative sample of work lead and supervisory personnel.
- Evaluate confined spaces to determine if they meet the criteria to be PRCSs.
- Maintain an inventory of all identified PRCSs at GRC that include the following items for each PRCS:
    a. Assigned ID number
    b. Location
    c. Existing and potential hazards
    d. Special considerations for entry, such as high noise or temperature extremes
    e. Minimum personal protective equipment (PPE) for routine entry
    f. Other hazard controls
- Provide assistance to the entry supervisors in the preparation of the Confined Space Entry Permit (CSEP), NASA form GRC199, and associated documents.
- Review all CSEP requests to ensure they are complete, especially in the areas of hazard identification, control, and mitigation.
- Review and return the CSEP to the entry supervisor when the review is complete.
- Determine if additional controls may be required by OSB for extended duration for a CSEP. Explanations are required in order to improve future CSEP requests. Explanations are required if the request is rejected. They may be verbal, written, or electronic.
- Perform field inspections of confined space activities to ensure compliance with both NASA and OSHA requirements. These shall be documented in the Safety, Health and Environmental Tracking System (SHEtrak).
- Receive and review terminated CSEPs and associated documentation. This review is critical to the evaluation of a safety program. Lack of documentation, missing or incomplete documentation, or incorrect documentation on a CSEP shall be considered as significant and may indicate the need for retraining. Minor problems shall be noted and addressed immediately by the Entry Supervisor. Any other significant compliance issues shall be documented in the form of a safety violation.
- Maintain the canceled CSEPs in accordance with established GRC recordkeeping procedures.
- Perform the annual program evaluation for the Confined Space Entry Program and be responsible for the maintenance of the evaluation documents. This evaluation is performed to ensure compliance with this chapter and current regulations.

The physician, Medical Services, shall participate in determining the requirements for physical and medical examinations including their depth, scope, and frequency to support certification requirements for confined space entry activities. This is in accordance with NASA Procedural Requirement (NPR) 1800.1, NASA Occupational Health Program Procedures.

5.2 Facilities and Test Directorate

Within the Facilities Division, building managers shall:

- Be made aware of the presence of confined spaces, permit-required or not, in their respective buildings and facilities.
- Maintain awareness of any changes to the status of confined spaces in their building and facilities.

  NOTE: *Notifications to the building managers shall be made prior to modification of an existing confined space, addition of a confined space, or removal of a confined space. This is the responsibility of the project manager assigned to that task.*
- Report any new, removed, or modified confined spaces to the OSB.
- Ensure personnel in their buildings and facilities are aware of the presence of any PRCS or its changes.

Within the Testing Division, facility managers shall:

- Be made aware of the presence of confined spaces, permit-required or not, in their respective buildings and facilities.
- Maintain awareness of any changes to the status of confined spaces in their building and facilities.

  NOTE: *Notifications to the facility managers shall be made prior to modification of an existing confined space, addition of a confined space, or removal of a confined space. This is the responsibility of the project manager assigned to that task.*
- Report any new, removed, or modified confined spaces to the OSB.
- Ensure personnel in their buildings and facilities are aware of the presence of any PRCS or its changes.

5.3 Contracting Officer's Representative (COR)

The COR shall:

- Ensure contractor employees comply with the requirements of the GRC Confined Space Entry Program as given in this chapter:
  - The COR shall ensure the contractor has been notified of any PRCSs and their associated hazards in areas in which the contractor's employees will be working.
  - Compliance shall include the 2-year requalification training requirement, the medical evaluation, and the annual written authorization requirement for personnel participating in the program.
  - The COR shall ensure offsite contractors submit documentation certifying their employees are trained, authorized to participate in confined space entry activities, and shall comply with the requirements of the GRC Confined Space Entry Program.
- Assist contractor employees as necessary to maintain control of the entry area for confined space entries:
  - This includes assisting in the removal of unauthorized personnel during a confined space entry activity.
  - This may include assisting with the coordination of operating schedules to reduce hazards to personnel.

5.4 Contractor Organizations

This Chapter meets the combined requirements of 29 CFR 1910.146 and 29 CFR 1926 Subpart AA. Since this chapter meets requirements for both, the chapter requirements shall be applied to both construction and general industry tasks at GRC.

Contractor organizations, maintenance or construction, shall be responsible for the following:

- Compliance with this chapter.
- Compliance with other applicable standards.
- Providing appropriate monitoring and other safety-related gear for the safe access and work in confined spaces at GRC. Maintenance, calibration, and "bump" test records are required for some of this equipment and must be made available for OSB review.
- Maintenance of records as identified in Section 7.0, Recordkeeping.

5.5 First-Line Supervisor (Supervisor)

The First-Line Supervisor (Supervisor) is the individual who is the day-to-day supervisor of a worker. The supervisor responsibilities include, but are not limited to:

- Certifying that personnel, in writing or electronically, participating in the GRC Confined Space Entry Program have met all requirements of the program. (This authorization shall be maintained by the supervisor or designee and a copy forwarded to the OSB.)
- Ensuring authorized entrants and attendants have the appropriate training for their confined space entry responsibilities, including a confined space entry class within the last 2 calendar years.
- Ensuring personnel are appropriately trained to perform their assigned duties safely while in a confined space.
- Ensuring the worker has an up-to-date annual medical evaluation to safely perform any tasks in the PRCS.
- Ensuring personnel are trained in the use of required PPE.
- Ensuring personnel use safe work practices and appropriate PPE during all work activities.

5.6 Entry Supervisor

The Entry Supervisor is responsible for:

- Complete training in accordance with this chapter. The frequency shall be initially and every two years for GRC personnel or every four years for construction personnel.
- Supervising all individuals and their actions while they are working under a CSEP. (The Entry Supervisor is not required to be the working supervisor for a particular person and may be employed by another employer.)
- Identifying the existing and potential hazards of the confined space, including any generated by the work activities.
- Developing an operating procedure for entry into and work in the confined space, as necessary.
- Initiating the CSEP.
- Forwarding the CSEP to the OSB for review and approval. (All supporting documents such as Safety Data Sheets (SDS') and ventilation setup drawings shall be attached prior to the submittal and become part of the CSEP.)
- Signing the CSEP after the requirements of the permit have been read and any questions or concerns have been answered, which signifies the Entry Supervisor's agreement to ensure compliance with the requirements of the CSEP and the GRC Confined Space Entry Program.
- Verifying the required annual medical evaluation is current via communications with the First-Line Supervisor.
- Ensuring that the authorized entrants and attendants read and sign the CSEP after all questions and concerns have been answered.
- Ensuring the approved CSEP is posted in a location near the entrance of the confined space.

- Ensuring all required entries on the CSEP are correct and completed in a timely manner.
- Ensuring necessary safety precautions have been taken, including properly identifying the PRCS while it is opened to prevent unauthorized entry.
- Verifying that the confined space and equipment within the confined space have been appropriately isolated and locked out/tagged out per Chapter 9 of this manual. (A copy of the GRC Switching and Lockout/Tagout Record (NASA GRC787) shall be attached if the lockout/tagout (LOTO) is "local.")
- Ensuring that atmospheric monitoring is conducted and meets the acceptable standards prior to allowing the workers to enter the PRCS.
- Verifying all ventilation equipment, monitoring equipment, communications equipment, and rescue equipment is present and operational.
- Ensuring that entry operations are consistent with the terms of the CSEP and that acceptable environmental conditions are present.
- Ensuring that any line-powered electrical equipment used for confined space work utilizes a ground fault circuit interrupter.
- Ensuring appropriate barricades and signs are utilized to keep unauthorized persons away from the confined space and to help protect entrants from external hazards.
- Ensuring the attendant remains outside of the confined space at all times during the entry operations.
- Ensuring appropriate measures are taken to remove unauthorized persons who are in or near the confined space. (This may include contacting a COR or Site Security for assistance.)
- Cancelling the CSEP and terminating entry if acceptable environmental conditions are not present or if the conditions or work procedures described on the CSEP or the operating procedure change.
    - The OSB shall be notified of the situation.
    - The OSB, the Entry Supervisor, and any other required personnel shall evaluate the situation and determine requirements for future entry.
- Once the task is complete and no further entries are required, concluding the entry operation by as closing the confined space and terminating the CSEP.
- Forwarding the CSEP to the OSB after its termination.

5.7 Entrant

The entrants shall:

- Complete training in accordance with this chapter. The frequency shall be initially and every two years for GRC personnel or every four years for construction personnel.
- Sign the CSEP prior to entry to verify that the requirements of the permit have been read, understood, and any questions or concerns have been answered.
- Recognize potential hazards, including symptoms and consequences of exposure to the hazards within the PRCS.
- Ensure all isolations and LOTO are performed as required by the CSEP and appropriate LOTO procedures.
- Inspect the entrance and exit routes and ensure that entry into and exit from the confined space can be made safely.
- Use PPE in accordance with the manufacturers' recommendations and training received.
- Either the Entrant or Entrant's Representative shall witness or perform the required atmospheric monitoring.

- Enter the PRCS only after ensuring that all the requirements of the CSEP have been met.
- Maintain effective and frequent communication with the attendant while in the confined space.
- Perform all tasks in a safe manner.
- Notify the attendant and exit the confined space whenever any warning sign or symptom of exposure to a dangerous situation is recognized or a prohibited condition is detected.
- Exit the PRCS immediately if the attendant orders an evacuation or if danger is perceived.
- Ensure all required equipment is removed from the PRCS at the end of the task.
- At the end of the task or during breaks, ensure the PRCS is left in a safe condition, preventing the inadvertent entry of unauthorized personnel.

5.8 Safety Attendant (Attendant)

The attendants shall:

- Complete training in accordance with this chapter. The frequency shall be initially and every two years for GRC personnel or every four years for construction personnel
- Sign the CSEP to verify that the requirements of the permit have been read, understood, and any questions or concerns have been answered.
- Verify that communications equipment for the attendant and entrant is present and operational, as applicable.
- Verify that communications equipment for summoning rescuers is present and operational, as applicable.
- When possible, establish an area around the confined space entry point to prevent interference with the entry or the inadvertent entry of unauthorized personnel into the PRCS.
- Either the Safety Attendant or the Safety Attendant's Representative shall witness or perform the required atmospheric monitoring.
- Remain immediately outside the entrance to the confined space area the entire time the confined space is occupied and monitor the entry of only one confined space area at a time.
    - Two or three confined spaces may be monitored at once provided the entries are very close; the attendant may monitor them simultaneously from a central location, and the work load is sufficiently light to be able to perform the task without placing any entrant at risk.
    - Conversely, more than one attendant may be required at a single PRCS if the tasks being performed are of sufficient complexity or number.
- Recognize potential hazards, including symptoms and consequences of exposure to the hazards, and monitor activities inside and outside the PRCS to ensure that it is safe for the entrants to remain in the confined space.
- Be aware of possible behavioral effects of exposure to low oxygen or toxic chemicals.
- Instruct entrants to evacuate the confined space immediately if:
    - a prohibited condition is detected
    - symptoms or behavioral effects of hazard exposure are detected
    - a situation that could endanger the entrants is detected inside or outside of the confined space
    - the attendant must leave the workstation or cannot effectively and safely perform the duties of an attendant

- Maintain an accurate count of all persons in the confined space as well as the approximate time each entrant has spent within the space.
- Maintain effective and frequent communication with the entrants while they are within the confined space.
- Summon rescue and other emergency aid as soon as it is determined that the entrants cannot exit or escape from the confined space hazards without assistance. (The attendant shall not enter the confined space to rescue or assist entrants, but may use in-place retrieval methods such as a tripod, retrieval line, and harness.)
- Prevent unauthorized personnel from entering the confined space entry area or interfering with the work in progress.
    - Contact the Entry Supervisor if the individual refuses to leave or is affecting the safety of the Entrant(s) or other workers.
    - Instruct the Entrant to immediately exit the PRCS if his/her safety has been compromised by the unauthorized personnel.

5.9 Human Capital Development Branch Chief

The Human Capital Development Branch Chief is responsible for maintaining records for civil servant completion of the Confined Space Entry course.

6.0 REQUIREMENTS

6.1 Confined Space Entry Training (*29 CFR 1910.146*)

All GRC employees and contractors involved with entry into or working in confined spaces shall have training in confined space entry. With respect to site personnel, SATERN Course GRC–4R0241 or its acceptable equivalent shall be completed initially and every 2 years thereafter while participating in the Confined Space Entry Program. Construction contractors shall provide proof of initial training in Confined Space entry and re-training every 4 years.

The training and review shall familiarize personnel with the following:

- The PRCS found at GRC and how to identify them
- Potential hazards involved with confined space entry, including the signs and symptoms of exposure to these hazards
- Monitoring atmospheric and other conditions within and around the PRCS
- Various methods of mitigating the effects of hazards, including ventilation, PPE, and LOTO
- The procedures that may be required for work within a PRCS
- Responsibilities of the Attendant, Entrant, Entry Supervisor, and the OSB
- Methods of communication
- Response procedures for emergencies and abnormal conditions
- Completing the CSEP

The Confined Space Entry training is the primary training for participation in this program. However, the worker is required to also be trained to safely perform assigned tasks while in the PRCS. This includes training in PPE and nonentry rescue equipment.

It shall be the responsibility of the First-Line Supervisor to ensure the worker has up-to-date training and qualifications to safely perform any tasks in the PRCS.

It shall be the responsibility of the Entry Supervisor to verify the required training and qualifications are current via communications with the First-Line Supervisor.

6.2 Medical Evaluation (*NASA NPR 8715.3 and NPR 1800.1*)

The minimum medical evaluation requirements for entry into a PRCS are given in Appendix B of NASA NPR 1800.1. They shall include:

- A medical and occupational history
- Physical examination with focus on employee's ability to carry out assigned duties and detection of any disease or abnormality that would make it difficult to work within confined spaces
- Audiogram
- Visual acuity, depth perception, and color vision (or demonstration of employee's ability to see and hear warnings, such as flashing lights, buzzers, and sirens)
- Discretionary tests including ECG, chest x-ray (baseline), urinalysis (dipstick), and pulmonary function
- Job certification with any limitations identified by the medical professional

The frequency of the medical evaluation shall be no more than every 2 years. Specific medical evaluation requirements for respiratory protection or other certifications may require more frequent evaluations to be performed. Medical evaluations for specific exposures may be required.

6.3 Postings (*29 CFR 1910.146*)

The PRCSs shall be listed on the Confined Space Inventory as the OSB becomes aware of them. Identification numbers are assigned to those listed. These identification numbers are not required to be permanently identified at the confined space point, but it is recommended to do so.

The PRCSs shall be identified when they may be opened without controls, tools or keys; when opened, or during an entry. At the GRC, the sign or sticker shall be a white, black, and red danger sign with the wording (or equivalent):

An approved CSEP shall be posted at or near the entry to a PRCS during all entries into that PRCS. A copy may be posted in lieu of an original if there are more entry points into a PRCS.

6.4 Communications *(29 CFR 1910.146)*

One or more methods of communications shall be maintained between the Entrant(s) and Attendant(s). Line-of-sight communication is preferable. However, this is often not possible at GRC because of the many configurations of the PRCSs. Verbal communications are next in preference, either direct voice or radio. This is followed by signaling by sound, rope tugs, or other methods.

Loss of communications shall require the entry to be terminated immediately.

The Entrant shall be considered incapacitated and unable to self-rescue in the event the Entrant does not exit the PRCS in what the Attendant considers to be a timely manner after losing communications. The Attendant shall then initiate the rescue procedures established by the CSEP.

6.5 Rescue Procedures *(29 CFR 1910.146)*

Rescue methods shall be addressed at the time the CSEP is requested.

Rescue planning takes into account the internal configuration of the confined space. Trap points, supports, probes, and other projections may require an entry rescue due to possible further injury by non-entry retrieval methods. Horizontal travel in confined spaces such as pipes, tunnels, and many tanks do not allow for non-entry retrieval methods due to the internal configuration of such spaces. The majority of entries into PRCS' at GRC fall into this category.

Nonentry rescue is the preferred method to be used for removal of an injured or incapacitated worker. This is typically done using a tripod, winch, body harness, and retrieval line.

The OSB must concur with the decision not to use a full-body harness with a tripod and/or winch system for the removal of an incapacitated worker. This is typically done where the use is either impractical or may cause harm due to internal configuration of the PRCS and must be addressed at the time the CSEP is submitted for evaluation.

Only trained and designated personnel may perform entry rescues. These personnel are provided by offsite municipal fire departments for both the Lewis Field and Plum Brook sites. The requirement for an entry rescue shall be designated on the CSEP to reduce response time due to the decision-making process.

> NOTE: The Authority Having Jurisdiction (AHJ) (for Fire and Life Safety) is the Facilities Division (FD) Safety and Occupational Health Manager.
>
> For NASA Centers/facilities, the AHJ shall establish response times to various facility locations to ensure that the fire response arrives in a timely manner in order that appropriate action(s) are taken to mitigate the emergency situation
>
> Annual response assessments from stations to major facilities shall be conducted and recorded to ensure capability to reach the scene in a timely manner.

In certain cases it may not be possible to remove an airborne hazard to below the safe maximum limits as identified by OSHA or other consensus standards. A specific, detailed entry and work procedure shall be developed by the work organization with the assistance of the OSB. Final review and approval of the Confined Space Entry Permit using this procedure shall be the responsibility of the OSB Chief or designee.

The procedure may require the use of a standby Emergency Rescue Team. This team shall be jointly evaluated by the OSB and the AHJ. Concurrence must be given in writing for the use of that team.

Any rescue requires the immediate notification of the Emergency Dispatch. Radio is the preferred method for contacting the emergency dispatcher, but a telephone may be used. The internal telephone number is 911 for both sites. Outside telephone numbers, such as when using a cellular telephone, are (216) 433–8888 at Lewis Field and (419) 621–3222 at Plum Brook.

> ***NOTE:*** *Only the Emergency Dispatch at Lewis Field or Plum Brook shall summon offsite personnel. This is to prevent confusion and delay of response teams as well as maintain the security of both sites.*

6.6 Permit Process *(GLM–QS–1700.1)*

Entry into a PRCS shall require a CSEP (NASA GRC199) to be approved in advance of the entry. The CSEP is an authorization document that identifies the following:

- The confined space
- Type of work to be done within the space
- Known and potential hazards of the confined space and the work to be performed
- Required protective measures to ensure the safety of the authorized entrants
- Effective and termination dates denoting the authorized periods of entry

The Entry Supervisor is responsible for initiating a CSEP. The NASA GRC199 may be accessed at the NASA Glenn Electronic Forms page and either completed online or printed and completed manually. Completion instructions are provided with the CSEP.

The CSEP and all its associated documents comprise the entry and operating procedure. It is critical for the Entry Supervisor to submit all documentation to allow the OSB to perform an adequate evaluation of the request.

The CSEP is reviewed and approved by the OSB. A CSEP may have an active time period of up to 1 year. A CSEP request for an active period longer than 45 days for a routine maintenance task or 90 days for a project must be approved by the OSB.

The termination date of the extended CSEPs is typically no later than the end of the calendar year. The OSB may require a more detailed operating procedure for all actions taken by the entrants to perform the required tasks within the confined space. Significant changes in job scope, working conditions, or the work procedure require the entry and CSEP to be terminated and a new CSEP developed and approved.

Only members of the OSB may extend the termination date of a CSEP. All field copies (for multiple entry points) shall be made using the extended original to show the new termination date. All old copies shall be maintained for inclusion into the document package returned to the OSB at the termination of the CSEP.

6.7 Confined Space Entry Procedures *(GLM–QS–1700.1)*

1. **The Entry Supervisor reviews the work area and the task scope.**

   The Entry Supervisor determines if a work area is a confined space, has been or will need to be designated a PRCS, and entry is necessary to perform the desired task. Tasks are to be accomplished without entry into a PRCS or any confined space.

   The Entry Supervisor assesses the current and potential hazards of the confined space and the task to be performed. If the work area is not ordinarily designated a PRCS but the work introduces hazards that would downgrade the area to that status, a CSEP shall be required. If there is any question as to this, the OSB shall be consulted.

   A CSEP is required if the work area is designated a PRCS, whether permanently or for the task duration.

2. **Entry Supervisor initiates the CSEP.**

   The CSEP form may be completed online and emailed, printed for submittal, or completed by hand for submittal. The Completion Guide for Confined Space Entry Permits provides additional direction and may be printed with the form. As a minimum, the following shall be included on the CSEP prior to review:

   - Location of the confined space. (This needs to be as specific as possible, especially for a confined space that is not permanently designated as a PRCS.)
   - Description of the confined space.
   - PRCS identification number if it is known. (Leave the space blank if there is no assigned number or it is unknown to the Entry Supervisor. Notify the OSB if this is a new confined space.)
   - Brief but thorough description of the task and task processes. (This would include chemical usage methods, hot work, or any other process that may create a hazard for workers. Any special entry or work procedures shall be addressed at this point also. If there is not enough room to document the procedures a separate work procedure may be attached to the CSEP to capture the required information.)
   - List of chemicals either currently in or to be brought into the confined space. (The MSDS for each chemical and its application shall be attached.)
   - List of equipment to be used in the confined space for the task.
   - The Hazards Checklist on the CSEP shall be completed along with the mitigation or elimination method for each hazard, including the specific PPE to be used. This includes rescue requirements and methods. The Entry Supervisor requests any changes to the tripod, winch, and fully body harness typically used for non-entry rescue.

- Copy of the Glenn Research Center Switching and Lockout/Tagout Record, NASA GRC787, or similar LOTO planning document is recommended to be attached when a LOTO will be required for the work to safely proceed. (The same procedure applies for an Area Clearance when one is required.)
- Proposed monitoring requirements shall be given. (This monitoring is based on the possible exposures to workers and may cause the CSEP to be considered part of the occupational health monitoring records. The Entry Supervisor may request the OSB to determine the required monitoring. An example of this would be if there asbestos removal were taking place in a PRCS. The monitoring data could include a copy of the CSEP work controls and exposure time.)
- Proposed effective and termination dates of the CSEP.

The CSEP shall then be submitted to the OSB for review. The Entry Supervisor's name and telephone number shall be printed on the CSEP request.

3. The CSEP is reviewed by the OSB.

The review process shall be the same for all reviewers. All health and safety concerns shall be addressed regardless of the reviewer's organization. The Entry Supervisor shall be contacted if there are any questions or concerns. The review process steps include the following:

- The OSB shall review the confined space and proposed CSEP to determine if one will be required for the task. The CSEP shall be returned to the Entry Supervisor with an explanation if no CSEP will be required.
- All section entries shall either be marked N/A or have an appropriate response.
- Verify the Identification Number if one is given for the PRCS. Investigate if there is a discrepancy between the database information and that given on the CSEP. Notify the OSB Chief if the database requires correction when the program Point-of-Contact is not available.
- Review the work description.
- Review the chemicals and equipment being brought into or resident in the confined space.
- Review the other identified hazards and their associated controls, including PPE. Changes away from the standard non-entry rescue equipment (tripod, winch, full body harness) may be approved by the OSB with supporting evidence of the reason(s).
- Evaluate or determine the monitoring to be performed, who will perform the monitoring, and how the monitoring records will be maintained. As a minimum, a copy of the monitoring records shall be attached to the original copy of the CSEP for records maintenance.
- The OSB shall sign the CSEP if approved. The CSEP with its supporting documents will form the entry and operating procedure for the task.
- The CSEP shall be returned to the Entry Supervisor with attached comments if the CSEP is rejected for insufficient information or inadequate controls.
- The Entry Supervisor reviews the approved CSEP.
    - The Entry Supervisor shall review the CSEP to ensure all changes made by the OSB are understood. If there are any questions or concerns they shall be addressed to the appropriate group at this time.
    - After review, the Entry Supervisor shall sign the CSEP to indicate understanding of the approved requirements and agreement to enforce them. The CSEP shall not be signed if there are questions or concerns with the CSEP.

4. The Entry Supervisor reviews the approved CSEP with the authorized Entrants and Attendants.

- Only personnel with appropriate training and work knowledge shall be approved for work in a PRCS. It is the Entry Supervisor's responsibility to verify personnel are trained and knowledgeable for the assigned task(s).
- Only the Entry Supervisor may approve Entrants and Attendants. This shall be done prior to a worker's first entry into the PRCS.
- Each individual shall sign the CSEP after an opportunity to have any questions and concerns with the CSEP are resolved.

5. The PRCS is prepared for entry.

- The Entry Supervisor shall ensure that all required ventilation equipment, monitoring equipment, communications equipment, and rescue equipment are present and operational. Entrants and Attendants shall be trained in the proper use of this equipment.
- The Entry Supervisor shall ensure that all required LOTO activities are completed prior to entry whenever possible. These activities are performed for electrical equipment, moving machinery, and piping that may allow hazards to enter the confined space.

NOTE: *Special operating procedures may be required if LOTO is not possible either prior to entry or due to system integrity or operational concerns. This shall be addressed at the time of submittal to the OSB to ensure personnel safety in the PRCS.*

- A Hot Work Permit is secured for any welding, grinding, or spark producing work in accordance with Chapter 28 of the Glenn Safety Manual. This shall be designated on the CSEP.

NOTE: *CO^2 fire extinguishers shall not be used in or adjacent to confined spaces without the written concurrence of the OSB.*

- All electrical equipment has a ground fault circuit interrupter at the power source, unless the power source is an ungrounded portable generator, an ungrounded battery source less than 28 volts, or an ungrounded isolation transformer of less than 28 volts.
- The Entry Supervisor has ensured that electrical equipment used inside the confined space is properly insulated and grounded.
- A barrier and warning sign shall be placed outside the confined space entrance to ensure unauthorized personnel do not enter the confined space or interfere with the workers.
- Monitoring shall consist of oxygen content in percent by volume, flammable or explosive gases expressed in percent of lower explosive limit (LEL), carbon monoxide (CO) expressed in parts per million (ppm), and hydrogen sulfide (H2S) expressed in ppm. Monitoring shall be performed in the area(s) of the PRCS in which the Entrants will be passing through or working. Minimum acceptable limits, with the OSB approval, are
  - Oxygen content between 19.5 and 23.5% by volume
  - Less than 10% LEL
  - Less than 10 ppm CO
  - Less than 10 ppm H_2S
- Normal air content is the goal for GRC. Anything outside the range of normal air concentrations shall be considered unacceptable until investigated by the OSB. This range is
  - Oxygen content between 20.5 and 21.5% by volume
  - 0% by volume LEL
  - 0 ppm CO

- 0 ppm H_2S

- The OSB shall be notified immediately if the air sample results are unacceptable. With OSB approval, the PRCS may be ventilated and retested. The period of ventilation prior to retest will vary by size of the Space and the hazard detected. Continuous ventilation may be required. If the results are unsatisfactory after ventilation, the task shall be evaluated with respect to the identified hazard and appropriate measures taken. A new CSEP shall be submitted with the new controls detailed and further investigation as to the source of the contaminant.

- The attendant is positioned outside the confined space entrance. The attendant shall maintain an entry log for the Entrants to track time actually in the PRCS whenever exposure monitoring is performed.

6. Entry into the PRCS

The following actions shall be performed immediately upon entry into the PRCS:

- The communication system between the entrant and the attendant shall be tested to confirm its effectiveness. Communication between the entrant and the attendant shall be maintained to ensure the safety of the entrant.

- An alternate communications method should be available whenever possible. This will prevent the action of an unneeded non-entry or entry rescue.

- Working conditions shall be verified to be those noted on the CSEP. If any of the critical conditions (e.g., configuration, procedures, materials, or required equipment) specified on the Entry Permit change or if the nature of the work to be performed in the confined space changes, the entrants shall exit the confined space. A new CSEP may be required prior to reentry.

- Note any changes to the PRCS for report to the OSB.

- Any new conditions or information not on the OSB's list shall also be reported to OSB.

7. Confined Space Entry Permit Termination

The following actions shall be performed when the work within the confined space has been completed:

- All work materials and equipment shall be removed when no longer required in the PRCS.

- The attendant shall verify that all entrants have exited the confined space.

- The PRCS shall be closed or barricaded and posted to prevent unauthorized entry.

- If all work is completed, the Entry Supervisor shall ensure the equipment is restored to operational readiness.

- If appropriate, the Entry Supervisor shall terminate the CSEP and forward it and all associated documentation to the OSB.

6.8 Audits and Inspections (*29 CFR 1910.146* and *GLM–QS–1700.1*)

- The OSB shall monitor confined space activities to ensure compliance with this chapter. SHEtrak inspections are the primary method of documenting this monitoring, but targeted audits may also be performed and documented. Significant discrepancies shall be documented and forwarded to the OSB Chief.

- Confined Space Program documents shall be reviewed annually by the OSB for compliance with this chapter. The preferred method is for the documents to be reviewed immediately upon receipt by the OSB. All entries shall be complete and accurate. Any discrepancies require the Entry Supervisor to correct the CSEP and supporting documents in such a manner as to not obscure the act of correction. The corrections shall be initialed and dated by the person performing the correction.

- Results of the Confined Space Program document reviews shall be forwarded to the designated the OSB for use in the annual evaluation of the Confined Space Entry Program.

The Confined Space Entry Program shall be evaluated annually by the OSB. The evaluation shall be based upon those reference documents noted in Section 8 and the requirements of this chapter.

7.0 RECORDKEEPING

- Confined Space Entry Permit, GRC199, and supporting documentation.—Terminated permits are maintained by the OSB for a minimum of 3 years. Active permits are maintained by the requesting organization.
- Calibration records for testing and monitoring equipment.—Maintained by the appropriate organization(s) for a minimum of 3 years.
- Training records.—Maintained by the Human Capital Development Branch and/or Contractor Organizations.
- Medical Evaluation Records (baseline and others).—Maintained by Medical Services and/or Contractor Organizations.
- Exposure Assessment Records shall be maintained by the Safety and Health Division or a Contractor Organization, as appropriate.
- Confined Space Audit Results – Maintained by the OSB as support documentation for the Annual Program Evaluation.
- Annual Program Evaluation – Maintained by the OSB.
- Annual Evaluation of Rescue Services – Maintained by the FD Safety & Occupational Health Manager.
- Safety, Health, and Environmental Tracking System (SHEtrak) inspections and findings shall be maintained in the SHEtrak system.

8.0 REFERENCES

Document number	Document name
29 CFR 1910.146	Permit-required confined spaces
29 CFR 1910.268	Telecommunications
29 CFR 1910.269	Electrical Power Generation, Transmission, and Distribution
29 CFR 1926 Subpart AA	Confined Spaces in Construction
NPR 1800.1	NASA Procedural Requirement, NASA Occupational Health Program Procedures
NPR 8715.3	NASA Procedural Requirement, NASA General Safety Program
GLM–QS–1700.1	NASA Glenn Safety Manual, Chapter 9, Lockout/Tagout
GLM–QS–1700.1	NASA Glenn Safety Manual, Chapter 35, Digging, Trenching, & Excavating

APPENDIX A.—DEFINITIONS AND ACRONYMS

Acceptable environmental conditions.—The conditions that must exist in a confined space to allow entry and to ensure that authorized entrants can safely enter into and work within the space.

Attendant.—An individual stationed outside the confined space to monitor and control the PRCS area.

Entrant.—A trained individual whose work assignment requires entry into a PRCS.

Code of Federal Regulations (CFR)

Confined space.—A space that has each of the following three characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work
- Has limited or restricted access for entry or exit, making it difficult for someone to enter or to rescue an individual in case of emergency
- Is not designed for continuous worker occupancy

Confined spaces include, but are not limited to, storage tanks, pits, vats, reaction vessels, ventilation and exhaust ducts, boilers, silos, sewers, manholes, tunnels, trenches, underground utility vaults, and pipelines.

Confined Space Entry Permit (CSEP) (NASA GRC199).—A printed document that authorizes entry and work by personnel into a confined space. The CSEP lists the hazards and associated controls for these hazards for the entry.

Contracting Officer's Representative (COR)

Controlling Employer - The employer acting as the primary source of information regarding the confined space and coordinating the entries. GRC retains this position as a normal circumstance.

Engulfment.—The surrounding and effective capture of a person by a liquid or finely divided solid substance.

Entry.—The action by which a person passes through an opening into a confined space and any ensuing work in that space. Entry is considered to have occurred as soon as any part of the entrant's body breaks the plane of any opening into the confined space.

Entry Supervisor.—The designated individual who has charge of the entry into the confined space. The Entry Supervisor is responsible for ensuring the safety and entry requirements specified in the CSEP are met, authorizing the entry, overseeing entry operations, and terminating the CSEP.

Entry Employer – The employer of the personnel actually entering the confined space.

Glenn Research Center (GRC)

Hazardous atmosphere.—An atmosphere that may expose employees to the risk of death, incapacitation, injury, acute illness, or impairment of one's ability to self-rescue from one or more of the following causes:

- A flammable gas, vapor, or mist in excess of 10 percent of the lower explosive limit (LEL)
- An airborne combustible dust at a concentration that obscures vision at a distance of 5 feet or less
- An atmospheric oxygen concentration below 19.5 percent or above 23.5 percent
- An atmospheric concentration of any substance for which exposure could occur in excess of its permissible exposure limit (PEL) or threshold limit value
- Any atmospheric condition recognized as immediately dangerous to life or health

Host Employer – The primary site employer of a multi-employer site.

Hot work.—All heat-, spark-, or flame-producing operations. This is further defined Chapter 28 of the Glenn Safety Manual.

Immediately dangerous to life or health.—Any condition that poses an immediate or delayed threat to life or that could cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from the confined space.

Isolation (Lockout/Tagout).—A process by which the confined space and systems within the confined space are removed from service, and protected against the inadvertent release of energy or material. This shall be performed in accordance with Chapter 9 of the Glenn Safety Manual.

Lower explosive limit (LEL).—The minimum concentration (usually expressed in percent by volume at sea level) of a flammable gas or vapor in air that will ignite if an ignition source is present. Lower flammable limit (LFL) is an equivalent term used by some professions.

NASA Procedural Requirement (NPR)

Occupational Safety and Health Administration (OSHA)

Operational Safety Branch – The OSB is the designated branch within the GRC Safety and Mission Assurance Directorate required to develop and oversee a safety program for entries into confined spaces at GRC

Oxygen-deficient atmosphere.—An oxygen concentration of less than 19.5 percent by volume.

Oxygen-enriched atmosphere.—An oxygen concentration greater than 23.5 percent by volume.

Permissible exposure limit (PEL).—The maximum 8-hour time-weighted-average (TWA) concentration of an airborne contaminant to which an employee may be exposed, specified in 29 CFR 1910, Subpart Z.

Permit-Required Confined Space (PRCS).—A confined space which has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere (e.g., oxygen-deficient, oxygen-enriched, flammable, explosive, toxic, or otherwise harmful)
- Contains a material that has the potential for engulfing an entrant
- Has an internal configuration such that an entrant could be trapped or asphyxiated because of inwardly converging walls or a floor that slopes downward and tapers to a smaller cross section
- Contains any other recognized serious safety or health hazard (e.g., need for LOTO provisions, need for personal protective equipment)

Personal protective equipment (PPE)

Point of contact (POC)

Threshold limit value (TLV).—The time-weighted-average (TWA) concentration for a normal 8-hour workday and a 40-hour workweek to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

APPENDIX B.—COMPLETION GUIDE FOR CONFINED SPACE ENTRY PERMITS

B.1 Identification of Permit-Required Confined Spaces (PRCSs)

Personnel in the OSB are responsible for the determination of a PRCS. The designation may be permanent or specific for a task or work procedure.

The OSB shall maintain an inventory of all permanently designated PRCSs for GRC. A copy of this inventory shall be accessible through the InfoBase System.

Whenever practical, the PRCSs within a building shall be labeled with the assigned Confined Space ID number. This number shall be either the system number of the space entry point or have the building ID format.

- At Lewis Field, this is the three-digit building number, followed by a dash, followed by a three-digit Confined Space number. For example, Building 12, Confined Space number 1 would be designated 012–001. It may be impractical for some PRCSs to be permanently labeled. The inventory list shall be used to determine the number in these cases.
- At Plum Brook, the format is 90 with the first digit of the building number followed by a dash, followed by the next last three digits of the building designation, followed by a dash, followed by a two-digit Confined Space number.

The description and location of the confined space needs to be accurate for a valid evaluation by the OSB.

Activities in adjacent areas may not be readily apparent to persons unfamiliar with the building or area containing the confined space. The Entry Supervisor should discuss planned activities with the Building Manager or other knowledgeable person if this is the situation.

A confined space may become a PRCS due to introduced hazards or abnormal conditions outside the confined space. This situation does not require the permanent identification of the confined space as a PRCS, but it does require the use of a CSEP and short-term designation as a PRCS.

Barricades or barriers should also be used to designate boundaries around opened PRCSs and to prevent unauthorized entry into a PRCS or interference with workers performing a task under a CSEP.

Determinations of confined space status shall be documented and maintained by the OSB for a minimum of 1 year and then may be discarded at the discretion of the program point-of-contact. These shall be used in the annual evaluation of the Confined Space Entry Program.

B.2 Evaluation and Control of Known and Potential Hazards

The Entry Supervisor shall evaluate the hazards associated with the task, the confined space, and the adjacent areas. Tasks being performed outside the confined may have a dramatic effect on the conditions inside. Those hazards listed below are a starting point for evaluation, not a full list. The evaluation shall include not only the hazard but the source of the hazard. Controls associated with hazards shall start with removal or prevention of the hazard and then go to mitigation if that is impractical or not possible.

1. **Types of hazards**
    - Hazardous atmospheres
        - Flammable/explosive
        - Toxic
        - Irritant or corrosive
        - Oxygen-deficient or oxygen-enriched
    - Physical hazards
        - Temperature

- Chemicals
- Noise
- Vibration
- Electrical and mechanical equipment

- Other hazards
  - Steam leaks
  - Radiation
  - Communication problems
  - Inadequate illumination

2. Control of chemical hazards

The SDS for each chemical resident within or introduced into the confined shall be attached to the CSEP prior to submittal to the OSB. Ensure the SDS is appropriate for the way the chemical will be used or treated. The quantity of or manner in which the chemical is used may change the identified hazards and controls. Hazards and control measures associated with the chemical are given on the SDS.

3. Personnel protective equipment

The recommended PPE and handling methods are given on the SDS. PPE such as gloves or respirators cannot be automatically used as the first line of defense against hazards. PPE may be used only if engineering controls and administrative controls do not eliminate the hazard. PPE is only intended to provide supplemental protection to proper engineering and administrative controls.

PPE for nonchemical hazards is evaluated in a manner similar to that for chemical hazards.

The Entry Supervisor shall recommend the PPE to be used on the CSEP. This selection is approved or adjusted by the OSB during the review process.

4. Atmospheric and chemical monitoring

Entry into a PRCS is prohibited until the atmospheric monitoring has been completed for oxygen level, LEL %, CO, H2S, and any toxic chemicals designated on the CSEP. Oxygen level shall be determined prior to or concurrent with LEL determination.

NOTE: *Continuous monitoring is recommended for all confined space entries. The Entry Supervisor shall justify the use of intermittent monitoring if that is desired.*

Trained individuals shall perform the initial daily monitoring for oxygen content, flammable gases, carbon monoxide, and hydrogen sulfide. If the individual conducting air testing must enter the confined space in order to complete the atmospheric testing, the individual shall "lead" with the instrument and terminate the confined space entry at the first indication of unsafe atmospheric conditions.

Toxic chemicals monitoring shall be performed or directed by the OSB, whether airborne or surface contamination.

All air monitoring results shall be documented and attached to the CSEP. A copy of the monitoring records shall also be maintained in the individuals' monitoring files if toxic chemicals monitoring is performed.

Surface monitoring of contamination or chemicals shall be documented and those results attached to the CSEP.

5. Respiratory protection

The OSB shall review the use and method of respiratory protection proposed by the Entry Supervisor. A knowledgeable member of the OSB shall be the deciding authority if there are any concerns with the

proposed equipment or method. The OSB shall consult with the Occupational Health Branch if additional information or review is required.

Respiratory protection is a form of PPE. Implementation of engineering or administrative controls before PPE to control or mitigate the hazard is required whenever practical.

6. Ventilation

NOTE: *Ventilation systems shall be designed to protect workers in the surrounding areas from the exhaust.*

The space shall be ventilated to eliminate or reduce the hazard if atmospheric monitoring indicates airborne contaminants to be at or above the PEL or immediately hazardous to life or health. The OSB shall review the use and method of ventilation proposed by the Entry Supervisor. A knowledgeable member of the OSB shall be the deciding authority if there are any concerns with the proposed equipment or method. Removal of the contaminant source is the preferred control with ventilation as a viable alternative.

If an immediately hazardous to life or health condition exists after ventilation, the entry shall be terminated and the situation investigated. A specific procedure addressing the situation, a new CSEP, and approval from the OSB Chief will be required for the work to proceed in that PRCS.

Airflow measurements may be required prior to each entry to ensure adequate ventilation. If the confined space is categorized as immediately dangerous to life and health, audible and/or visual warning devices shall be required to indicate ventilation failure.

Ventilation equipment (if required) shall be explosion-proof and comply with NFPA 70 and Section 500 of the National Electric Code (NEC) when combustible or flammable gases or vapors are present in levels of greater than 50% of the LEL. In addition, the bonding requirements of NEC Section 250 shall be met.

When elevated levels of combustible dusts or ignitable fibers or particulates may be present, ventilation equipment shall comply with Sections 502 and 503 of the NEC.

B.3 Communications

Communications shall be maintained between entrants and attendants. The method(s) to be used shall be designated in the CSEP. If voice communications are inadequate due to noise, distance, personal protective equipment, or other conditions, an alternate communication system such as visual contact, rope signals, radios, light, or other alarm devices shall be used.

Loss of communications constitutes a valid reason for terminating the entry. Modification of the CSEP by the OSB and the Entry Supervisor shall be required if the initial communications method(s) is inadequate.

Communications with the emergency response organizations shall be addressed. The contact method for an emergency shall be determined and addressed in the communication section of the CSEP.

B.4 Rescue Procedures

Rescue methods shall be addressed at the time the CSEP is requested.

Rescue planning takes into account the internal configuration of the confined space. Trap points, supports, probes, and other projections may require an entry rescue due to possible further injury by non-entry retrieval methods. Horizontal travel in confined spaces such as pipes, tunnels, and many tanks do not allow for non-entry retrieval methods due to the internal configuration of such spaces. The majority of entries into PRCS' at GRC fall into this category.

Non-entry rescue is the preferred method to be used for removal of an injured or incapacitated worker. This is typically done using a tripod, winch, body harness, and retrieval line. Only trained and designated personnel shall perform entry rescues. Offsite municipal fire departments provide the Entry Rescue Teams for both the Lewis Field and Plum Brook sites. The requirement for an entry rescue shall be designated on the CSEP to reduce response time. Any rescue requires the immediate notification of the Emergency Dispatch. Radio is the preferred method for

contacting the emergency dispatcher, but a telephone may be used. The internal telephone number is 911 for both sites. Outside telephone numbers, such as when using a cellular telephone, are (216) 433–8888 at Lewis Field and (419) 621–3222 at Plum Brook.

> ***NOTE:*** *Only the Emergency Dispatch at Lewis Field or Plum Brook shall summon offsite personnel. This is to prevent confusion and delay of response teams as well as maintain the security at both sites.*